

WHAT IS CLAIMED IS:

1. An optical encoder comprising:
 - 5 light irradiating system;
 - an optical scale having a grating for transmitting or reflecting incident light;
 - 10 light-receiving elements disposed in a plurality of different directions; and
 - 15 an optical system constructed so as to amplitude-modulate light traveling from said light irradiating system to said optical scale and transmitted or reflected by the grating, by a dividing element in which a plurality of V-shaped grooves are juxtaposed, and so as to divide the amplitude-modulated light into beams along a plurality of different directions to guide the beams to the respective light-receiving elements;
 - 20 wherein said dividing element is comprised of repetitions of such structure that a plurality of V-grooves consisting of planes of mutually different angles are juxtaposed at a predetermined pitch.
- 25 2. The optical encoder according to Claim 1, wherein said dividing element forms at least one set of beams having a phase relation of 180°.
3. The optical encoder according to Claim 2, 26 wherein said dividing element comprises repetitions of

four types of different planes.

4. The optical encoder according to Claim 1,
wherein said dividing element and said optical scale
5 are comprised of a common member.

5. The optical encoder according to Claim 4,
wherein a portion functioning as said dividing element
of said common member is provided in an outside region
10 or in an inside region of said grating.

6. An optical encoder comprising:
light irradiating system;
an optical scale comprising scale slits of a
15 periodic structure;
a light-receiving element; and
an optical system constructed so as to make
light traveling from said light irradiating system to
the scale slits of a first region of said optical
scale, incident to the scale slits of a second region
20 of said optical scale by a mirror or another optical
element to guide the light having passed via the scale
slits of the second region to said light-receiving
element;
25 wherein in said optical scale the number of the
scale slits of said first region is different from the
number of the scale slits of said second region.

7. The optical encoder according to Claim 6,
wherein said optical scale is constructed so as to be
rotatable relative to the other members, wherein said
first region is disposed in an inside diameter side
5 while said second region in an outside diameter side,
and wherein the number of the scale slits of said first
region is smaller than the number of the scale slits of
said second region.

10 8. The optical encoder according to Claim 6,
wherein said optical scale is constructed so as to be
rotatable relative to the other members, wherein said
first region is disposed in an outside diameter side
while said second region in an inside diameter side,
15 and wherein the number of the scale slits of said first
region is larger than the number of the scale slits of
said second region.

9. The optical encoder according to Claim 6,
20 wherein said optical scale is constructed so as to be
rotatable relative to the other members and wherein a
ratio of the numbers of the scale slits of said first
and second regions is approximately equal to a ratio of
distances from a rotation center of relative rotation
25 of said optical scale to radial centers of said
respective regions.

10. An optical encoder comprising:

light irradiating system;

an optical scale comprising scale slits of a periodic structure;

5 a light-receiving element; and

an optical system constructed so as to make light traveling from said light irradiating system to the scale slits of a first region of said optical scale, incident to the scale slits of a second region 10 of said optical scale by a mirror or another optical element to guide the light having passed via the scale slits of the second region to said light-receiving element;

wherein in said optical scale a surface 15 provided with the scale slits of said first region is different from a surface provided with the scale slits of said second region.

11. The optical encoder according to Claim 10,
20 wherein said optical scale is constructed so as to be rotatable relative to the other members, wherein said first region is disposed in an inside diameter side while said second region in an outside diameter side, and wherein the surface provided with the scale slits 25 of said first region is disposed so as to be closer to said optical element.

12. The optical encoder according to Claim 10,
said optical encoder being used for detection of an
angle or a speed of relative rotation of said optical
scale.

5

13. An optical encoder comprising:
light irradiating system;
an optical scale comprising scale slits of a
periodic structure;

10

a light-receiving element; and
an optical system constructed so as to make
light traveling from said light irradiating system to
the scale slits of a first region of said optical
scale, incident to the scale slits of a second region
15 of said optical scale by a mirror or another optical
element to guide the light having passed via the scale
slits of the second region to said light-receiving
element;

20

wherein in said optical scale the scale slits
of said first and second regions are comprised of
grooves of V-shaped cross section and wherein slope
angles are different from each other between the
grooves of the V-shaped cross section of the scale
slits in said first and second regions.

25

14. The optical encoder according to Claim 13,
wherein the slope angles of the V-shaped grooves of the

scale slits in said first region are smaller than those in said second region.

15. The optical encoder according to Claim 13,
5 said optical encoder being used for detection of an angle or a speed of relative rotation of said optical scale.

16. An optical encoder comprising:
10 light irradiating system;
an optical scale comprising scale slits of a periodic structure;
a light-receiving element; and
an optical system constructed so as to make
15 light traveling from said light irradiating system to the scale slits of a first region of said optical scale, incident to the scale slits of a second region of said optical scale by a mirror or another optical element to guide the light having passed via the scale slits of the second region to said light-receiving element;
wherein in said optical scale the scale slits of said first and second regions are comprised of grooves of V-shaped cross section and wherein the V-shape of the grooves of the scale slits in said second region comprises slopes of N types of angles in a number of P/N in one period where P is a pitch of the

periodic structure of the scale slits and N a natural number.

17. The optical encoder according to Claim 16,
5 said optical encoder being used for detection of an angle or a speed of relative rotation of said optical scale.

18. An optical encoder comprising:
10 light irradiating system;
1. an optical scale comprising scale slits of a periodic structure;
a light-receiving element; and
an optical system constructed so that light
15 traveling from said light irradiating system to the scale slits of a first region of said optical scale and reflected by the first region is reflected and condensed via only one condensing mirror onto the scale slits of a second region of said optical scale and so
20 that the light having passed via the scale slits of the second region is guided to said light-receiving element.

19. The optical encoder according to Claim 18,
25 wherein said second region performs wavefront division by a difference between reflecting directions.

20. The optical encoder according to Claim 19,
wherein said first region has a periodic structure of
reflecting portions and transmitting portions.

5 21. The optical encoder according to Claim 19,
wherein said first region has a periodic structure of
flat portions and groove portions of V-shaped cross
section.

10 22. The optical encoder according to Claim 21,
wherein said second region emits beams in four
different directions from different portions,
respectively.

15 23. The optical encoder according to Claim 18,
wherein said first region has a periodic structure for
giving reflected light a periodic path difference of a
half wavelength.

20 24. The optical encoder according to Claim 18,
wherein said first region has a periodic structure of
flat portions and groove portions of V-shaped cross
section and periodic structure in which there appears a
difference of a half wavelength in every other width of
25 the flat portions.

25. The optical encoder according to Claim 18,

wherein said first region has a periodic structure of groove portions of V-shaped cross section and periodic structure in which there appears a difference of a quarter wavelength in every other depth of grooves in
5 the groove portions of the V-shaped cross section.

26. The optical encoder according to Claim 18,
said optical encoder being used for detection of
information on relative rotation of said optical scale.
10

27. The optical encoder according to Claim 18,
said optical encoder being used for detection of
information on relative translational displacement of
said optical scale.

15
28. The optical encoder according to Claim 18,
wherein reflected light from said second region is
received by said light-receiving element.

20
29. The optical encoder according to Claim 18,
wherein said condensing mirror is disposed on an
optical element in said light irradiating system.

30. A driving system comprising:
25
a driver system;
a control system for controlling driving of
said driver system; and

an optical encoder for detecting information on the driving of said driver system to output a signal to said control system, said optical encoder comprising:

- (1) light irradiating system;
- 5 (2) an optical scale having a grating for transmitting or reflecting incident light;
- (3) separate light-receiving elements disposed in a plurality of different directions; and
- (4) an optical system constructed so as to 10 amplitude-modulate light traveling from said light irradiating system to said optical scale and transmitted or reflected by the grating, by a dividing element in which a plurality of V-shaped grooves are juxtaposed, and so as to divide the amplitude-modulated 15 light into beams along a plurality of different directions to guide the beams to the respective separate light-receiving elements;

wherein said dividing element is comprised of repetitions of such structure that a plurality of V-grooves consisting of planes of mutually different angles are juxtaposed at a predetermined pitch.

31. A driving system comprising:
 - a driver system;
 - 25 a control system for controlling driving of said driver system; and
 - an optical encoder for detecting information on

the driving of said driver system to output a signal to said control system, said optical encoder comprising:

- (1) light irradiating system;
 - (2) an optical scale comprising scale slits of a periodic structure;
 - (3) a light-receiving element; and
 - (4) an optical system constructed so as to make light traveling from said light irradiating system to the scale slits of a first region of said optical scale, incident to the scale slits of a second region of said optical scale by a mirror or another optical element to guide the light having passed via the scale slits of the second region to said light-receiving element;
- wherein in said optical scale the number of the scale slits of said first region is different from the number of the scale slits of said second region.

32. A driving system comprising:
- a driver system;
 - a control system for controlling driving of said driver system; and
 - an optical encoder for detecting information on the driving of said driver system to output a signal to said control system, said optical encoder comprising:
 - (1) light irradiating system;
 - (2) an optical scale comprising scale slits of

a periodic structure;

(3) a light-receiving element; and

(4) an optical system constructed so as to make
light traveling from said light irradiating system to
5 the scale slits of a first region of said optical
scale, incident to the scale slits of a second region
of said optical scale by a mirror or another optical
element to guide the light having passed via the scale
slits of the second region to said light-receiving
10 element;

wherein in said optical scale a surface
provided with the scale slits of said first region is
different from a surface provided with the scale slits
of said second region.

15

33. A driving system comprising:

a driver system;

a control system for controlling driving of
said driver system; and

20 an optical encoder for detecting information on
the driving of said driver system to output a signal to
said control system, said optical encoder comprising:

(1) light irradiating system;

(2) an optical scale comprising scale slits of
25 a periodic structure;

(3) a light-receiving element; and

(4) an optical system constructed so as to make

light traveling from said light irradiating system to
the scale slits of a first region of said optical
scale, incident to the scale slits of a second region
of said optical scale by a mirror or another optical
element to guide the light having passed via the scale
slits of the second region to said light-receiving
element;

wherein in said optical scale the scale slits
of said first and second regions are comprised of
grooves of V-shaped cross section and wherein slope
angles are different from each other between the
grooves of the V-shaped cross section of the scale
slits in said first and second regions.

- 15 34. A driving system comprising:
 a driver system;
 a control system for controlling driving of
 said driver system; and
 an optical encoder for detecting information on
20 the driving of said driver system to output a signal to
 said control system, said optical encoder comprising:
 (1) light irradiating system;
 (2) an optical scale comprising scale slits of
 a periodic structure;
 (3) a light-receiving element; and
 (4) an optical system constructed so as to make
 light traveling from said light irradiating system to

the scale slits of a first region of said optical scale, incident to the scale slits of a second region of said optical scale by a mirror or another optical element to guide the light having passed via the scale slits of the second region to said light-receiving element;

wherein in said optical scale the scale slits of said first and second regions are comprised of grooves of V-shaped cross section and wherein the V-shape of the grooves of the scale slits in said second region comprises slopes of N types of angles in a number of P/N in one period where P is a pitch of the periodic structure of the scale slits and N a natural number.

35. A driving system comprising:
a driver system;
a control system for controlling driving of
said driver system; and
an optical encoder for detecting information on
the driving of said driver system to output a signal to
said control system, said optical encoder comprising:
(1) light irradiating system;
(2) an optical scale comprising scale slits of
a periodic structure;
(3) a light-receiving element; and
(4) an optical system constructed so that light

traveling from said light irradiating system to the scale slits of a first region of said optical scale and reflected by the first region is reflected and condensed via only one condensing mirror onto the scale slits of a second region of said optical scale and so that the light having passed via the scale slits of the second region is guided to said light-receiving element.